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XXXIII.—*On the Pro-Embryos of the* Charæ.

By M. Pringsheim*.

It is generally supposed by the numerous observers of the germination of the *Charæ*, that their spores produce the plants immediately in germination.

This assertion is expressed most distinctly by Bischoff in his monographic treatise on the *Charæ*. After some brief remarks upon the direction of the germinating plant, dependent on the accidental position of the spore, Bischoff says†, "In any case, however, it is clear that in the *Charæ* an immediate development of the germ-plant from the spore takes place, without any trace of a primitive germinal structure, such as occurs in the other Cryptogamia of the higher orders; and even by this the position of these plants upon the boundaries of the two primary divisions of the vegetable kingdom is attested."

Certainly every one who has observed germinating *Charæ* will admit that this assertion is perfectly in accordance with the first and direct impression which germinating *Charæ* produce upon the observer, and has evidently misled all the more recent observers of the germination; for they differ in nothing from Bischoff in their conception of the structure produced from the spore.

Nevertheless this conception is false; and it is certain that the germinating spore does not directly give origin to the young plant, but that in the *Charæ*, as in the higher Cryptogamia, a pro-embryo is first formed in the germination, and upon this the first branches of the plant are subsequently formed by a normal process of gemmation. The proof of this assertion depends upon the history of the growth of the shoots of *Charæ*, for the complete representation of which we are indebted to Alex. Braun*. It likewise requires a thorough examination of the formation and structure of the lateral shoots given off from the nodes and leaf-axils of the *Charæ*.

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* Translated by W. S. Dallas, F.L.S., from the Monatsbericht der Akad. der Wiss. zu Berlin, April 1862, p. 225.

† G. W. Bischoff, 'Die Cryptogamischen Gewächse,' 1828, p. 10.

I suppose the general structure of the *Charæ* to be well known; and with regard to the history of the development of their branches I merely call attention here to the fact that every branch and every bud (or branch-rudiment) of the *Charæ*, as in the Cormophyta generally, terminates in a vegetative cone, from which the formation of the whole of the morphological segments (internodes, nodes, and leaves) issues directly or indirectly; and I may add, further, that the vegetative cone of the *Charæ* is formed, not by a complex cellular body, but of a single cell, which is therefore the vegetative cell. I further refer to the fact that the cortication of the joints of the stem and leaves depends upon the neighbouring nodes, the cortical segments descending from the upper nodes coalescing with those ascending from the lower nodes to form a coherent cortical coat.

It is well known that in the *Charæ*, as in leafy plants in general, branches issue from the leaf-axils at the nodes, which equally increase the stock and repeat the growth of the parent branch.

In *Chara fragilis*, to which species the following statements refer, only a single lateral branch usually issues from the younger nodes: this, as Al. Braun has shown, stands in the axil of the oldest leaf of the whorl. It differs from its parent shoot only in that the complete cortication of its first (lowest) joint takes place entirely from the upper node, its basilar node forming no ascending cortical segment.

In older nodes of this plant which have survived the winter, we find, on the contrary, a greater number of shoots rising from one whorl of leaves, and now no longer exclusively from the axil of the oldest leaf.

These later-produced lateral shoots appear at the same time more or less abnormally altered, and a closer examination shows that two kinds of structures, of very different morphological value, occur amongst them.

Some of them are distinguished from the quite normally barked shoot, produced at a much earlier period in the axil of the oldest leaf, by an entire absence or a deficient development of the bark on their lower parts. This alteration usually affects only the lowest joint and the leaves of the first whorl, but here and there also the following joints and whorls.

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* "Ueber die Richtungsverhältnisse der Saftströme in den Zellen der Characeen," Monatsber. der Berliner Akad. der Wiss. 1852 & 1853.

To distinguish them from others, I will call these shoots "naked-footed twigs." The manifold phenomena called forth by the various degrees of development of the bark on the lower joints of these naked-footed twigs I pass over here entirely; but, on the contrary, I indicate particularly that even these shoots, in their development, and especially in the formation of their morphological members from the vegetative cell always present at their apex, follow the general law of development of the shoots of *Chara*.

The second kind of twig-like structures, which occur with the naked-footed twigs on the older nodes which have passed through the winter, must strike the observer, even from their external appearance, by the far greater deviation of their lower parts from the normal structure of the shoots of *Charæ*. It is to these structures, under the name of "progerms of the twigs" (*Zweigvorkeime*), that I wish here in the first place to call attention.

Whilst every twig issuing from a node commences with a distinct joint, appearing green from the well-known chlorophyll-rows of the *Charæ*, which bears immediately above it the first normal node furnished with leaves, the progerms of the twigs commence with a perfectly colourless shorter or longer joint, in which the chlorophyll-rows are always wanting. This is followed by an extremely imperfectly developed and always *leafless* node, the place of which is even frequently occupied by a single cell, elongated into the form of a joint. Upon this, again, there follows a more or less elongated but always *naked* joint, which, in its appearance already presents a greater resemblance to the stem-joints of the *Charæ*; and this joint apparently bears the first circle of leaves.

But this also is remarkable for a disproportionate development of the parts, which is never seen on any other whorl of leaves: amongst the leaves apparently belonging to it one is constantly distinguished by its excessive growth, far exceeding any inequalities amongst the leaves of a whorl, that may occur now and then in normal whorls.

It is only from hence that the twig becomes perfectly normal, that is to say, the following joints, nodes, and leaves are exactly like *the first* joints, nodes, and leaves of a normal naked-footed or barked lateral twig; so that it evidently appears as if the true twig originates as a lateral shoot in the axil of the above-mentioned excessively developed leaf of the first whorl.

And this view is in fact fully confirmed by the developmental history, which at the same time furnishes an unexpected explanation of the nature of the excessively developed pseudo-leaf. Thus it shows that this does not belong as a leaf to the first circle of leaves, but that it is the apex of a distinct structure following a peculiar mode of growth, and that it is only under this leaf-like apex, and at a later period, that the first normal bud is produced and developed into a normal barked or naked-footed twig, which is only distinguished from other twigs of *Chara* by its basal node producing a few leaves which remain in a rudimentary state of development.

Now, it is from these little leaves coinciding in a circle with the end of that independent organ to which I give the name of "progerm of the twig" that it appears as if the twig above this whorl was the direct continuation of the joints below it.

The recognition of this gets rid of all the contradictions and abnormal appearances which strike us in the lower joints and the first whorls of these twigs so long as we start from the false assumption that the structure which I indicate as the apex of the progerm of the twig is the excessively developed oldest leaf of the first whorl; for neither the development of this progerminal apex, nor the form of its terminal cell, nor, lastly, the directions of the currents in its cells agree with the normal condition of the parts of a leaf.

The full significance of this progerm of the twig only becomes evident, however, by the comparative examination of the germinating plant.

The considerable deviations from the normal structure of the joints and nodes which are observed in the first joints and nodes of germinating *Charæ* are most simply explained by the same processes of formation which I have shown to occur in the progerms of the twigs.

The germination of the spore also commences with the formation of an *independent* organ following a law of growth *peculiar to itself*—a progerm, from the *leafless* nodes of which the leafy twigs sprout forth.

The progerms formed by the spore resemble in every respect the progerms of the twigs produced on the older nodes of plants which have passed the winter. They reach from the spore to the first whorl of leaves, and terminate here with the same excessively developed structure apparently belonging to the whorl, which has been regarded sometimes, as by the older observers, as the apex of the growing main stem, and sometimes, as by more recent investigators, as the first, disproportionately developed leaf of the first whorl.

It is, however, as already stated, neither the one nor the other, but the apex of a *leafless* provisional structure incapable of further development; and the leaflets in its vicinity, with which it apparently coincides to form a whorl, are, as in the progerms of the twigs, the rudimentary leaves of the basal node of the *first* normal shoot of the *Chara* formed at the base of the progerminal apex.

This proof of the occurrence of the progerm in the *Charæ* fills a sensible gap in the developmental history of those plants. The existence of leafless provisional structures, from which the twigs shoot forth, supports the conception, derived from the history of the formation of the parts, that the twigs of *Chara* are leafy shoots, and places the relationship of the *Charæ* to the Mosses in the clearest light.

To the form of the seminal filaments and of the rudiments of the fruit, in which the *Charæ* so strikingly approach the Mosses, we may now add the similar mode of production of the leafy twigs from buds originating on confervoid leafless progerms; for the progerms of the *Charæ* differ but little in their structure from the confervoid progerms of the Mosses, as is proved by the possible replacement of their few and defectively developed nodes by simple cells elongated into the form of joints. And although the more simple and throughout almost confervoid structure of the plant in the *Charæ,* as also the node-formation of their progerms, by which these externally resemble the leafy twigs, renders the recognition of the progerms and their distinction from the leafy twigs very difficult, still it is never possible to confound the progerms with leafy twigs, and no transition of a progerm into a leafy twig ever occurs; so that the morphological separation of the leafless progerms and the leafy shoots is just as sharply marked in the *Charæ* as in the Mosses.

Lastly, the complete morphological equivalence of the progerms in *Charæ* and Mosses shows itself most decidedly through the progerms of the twigs in the former; for, among all leafy plants, it is only on the stems and leaves of the Mosses that we find organs analogous to the progerms of the twigs of *Charæ.* These are the well-known root-like prothallia which occur on the stems and leaves of many Mosses, and which have been fully described by W. P. Schimper in his anatomical and morphological investigations on the Mosses*.

The *Charæ,* therefore, in their general process of development pass through similar stages to the Mosses.

They are leafy plants, without a main stem or main root, the whole of their twigs, like those of the Mosses, being produced as lateral shoots, either on other leafy twigs or on leafless progerms.

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* Compare the structures described by Schimper in his 'Recherches anatomiques et morphologiques sur les Mousses' (Strasburg, 1848), as "radicelles proembryonnaires sur les tiges" (p. 13), "excroissances proembryonnaires sur le limbe et à l'extrémité de la nervure des feuilles" (p. 15), and "radicelles proembryonnaires aux feuilles détachées de la tige" (p. 19).

In the structure of their antheridia and the development of their fruit they certainly present important deviations from the Mosses, which do not permit their complete systematic union with any group of Mosses; but, as in the form of the seminal filaments, so also in the original foundation of the fruit, they agree with the general formative process in the Mosses; for, although the period and the place of impregnation in the *Charæ* are not yet demonstrated, it may nevertheless be asserted with great probability, from well-known and not far-fetched analogies (to which we may now add the formation of the progerms), that in them also it is not the spore-cell which germinates into a prothallium, but a mother-cell preceding this by several generations, that is fertilized. The *Charæ* consequently stand evidently as a peculiar group of the section of Moss-like plants amongst the Cryptogamia.

Moreover, the unexpected occurrence of the progerm in the *Charæ* makes it appear to be a general law (to which, contrary to the earlier views, the *Charæ* are subject as well as Ferns and Mosses) that in all leafy plants the spore never can be directly the vegetative apex of the first leafy axis.

The further development of this preliminary communication will appear, with the necessary bibliographical references and figures, in the next part of my 'Jahrbuch für wissenschaftliche Botanik,' which is already in the press.

XXXIV.—*Description of a new Species of* Hydroporus, *Clairv.*

By the Rev. HAMLET CLARK, M.A., F.L.S.

Fam. **Dytiscidæ.**

Genus HYDROPORUS, Clairv.

H. tinctus, n. sp.

H. oblongo-ovalis, subparallelus, sat convexus, post medium paulo latior, ad apicem modice et rotunde productus, crebre punctulatus, leviter pubescens, subopacus, niger, obscure rufo notatus; capite inter oculos undique late et distincte depresso, sparsim punctulato, ad apicem rufo tincto; thorace antice emarginato, lateribus leviter rotundatis, basi sinuata ad medium (scutelli regione) angulata, sparsim et fortiter punctato, antice juxta marginem transverse punctato-striato, ad basin plus minus transverse depresso, ad baseos angulos plus fortiter plerumque foveolato, nigro; elytris thorace latioribus, cum thoracis margine angulum obtusum formantibus, post medium latioribus, leviter punctatis, sparsim pubescentibus, nigris, fascia lata inæquali transversa apud humeros, vitta marginali (post medium in maculam triangularem dilatata) haud apicem attingente, rufis vel rufo-fuscatis, hæ maculæ aliquando obsoletæ